

CLAIMS:

1. A polarization independent phase modulator (100) for light, comprising:
two transparent substrates (101, 107); and
a layer (104) of chiral liquid crystal mixture, between said substrates;
wherein said chiral liquid crystal mixture
5 is oriented in a helix oriented ground state;
is controllable between said ground state and a tilted state by means of an electric field;
has an effective refractive index which depends on the state of said liquid crystal mixture;
and
has a pitch that is sufficiently small to make the value of the refractive index substantially
10 independent of the polarization of the light.
2. A polarization independent phase modulator (100) according to claim 1 for
light having a wavelength longer than a predetermined wavelength λ , wherein said pitch is
smaller than λ/n , n being the larger of the extraordinary refractive index and the ordinary
15 refractive index of the liquid crystal mixture in a uniaxially oriented phase.
3. A polarization independent phase modulator (100) according to claim 2,
wherein said predetermined wavelength λ is 400 nm or, preferably, 350 nm.
- 20 4. A polarization independent phase modulator (100) according to claim 1,
wherein said pitch is smaller than 350 nm, and preferably smaller than 250 nm.
5. A polarization independent phase modulator (100) according to claim 1,
wherein said chiral liquid crystal mixture comprises liquid crystal molecules which are
25 dispersed in a network material.
6. A polarization independent phase modulator (100) according to claim 5,
wherein said network material is an anisotropic polymer network and wherein said dispersed

mixture consists of 10-60 percent by weight linear polymer molecules which are linked by 0.5-1 percent by weight cross-linking molecules.

7. A polarization independent phase modulator (100) according to claim 5,
5 wherein said network material has a laterally varying concentration (1002) such that lateral variations of said tilted state and thus of said polarization independent refractive index is provided upon application of a uniform electric field across said layer of liquid crystal mixture.
- 10 8. A polarization independent phase modulator (100) according to claim 1,
wherein at least one of said substrates (101, 107) is provided with a structured electrode (1101, 1102, 1103, 1200), which is operative to apply a laterally varying electric field across said liquid crystal molecules, thereby providing lateral variations in said tilted state and, as a consequence, lateral variations in said polarization independent refractive index.
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- 15 9. A polarization independent phase modulator (100) according to claim 1,
further comprising an optically static structure (1311, 1321, 1404) arranged between said substrates and having a refractive index that is different from the effective refractive index of the liquid crystal mixture in at least one of the liquid crystal mixture states, such that a light
20 modulating property is provided by an interface between said static structure and said layer of liquid crystal mixture.
10. A switchable lens (1502, 1802) comprising a polarization independent phase modulator (100) according to claim 1.
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11. A switchable lens (1502, 1802) according to claim 10, wherein said polarization independent phase modulator (100) further comprises circular symmetric electrodes (1103, 1200) arranged on said substrates (101, 107) and operative to apply a circular symmetric electric field across the layer (104) of liquid crystal mixture for inducing
30 circular symmetric refractive properties of said lens.
12. A switchable grating (1703) comprising a polarization independent phase modulator (100) according to claim 1.

13. A light source (1501, 1502) comprising a polarization independent phase modulator (1503) according to claim 1, wherein said phase modulator is operative to control the shape or the direction of light emitted from said light source.

5 14. An optical data storage system (1601 – 1605; 1701 – 1705) having an optical path and comprising a polarization independent phase modulator (1604; 1703) according to claim 1 arranged along said optical path.

10 15. An optical data storage system (1601 – 1605; 1701 – 1705) according to claim 14, said data storage system being a Compact Disc system, a Digital Video Disc system, or a Blu-ray system.

15 16. A camera system having an optical path and comprising a polarization independent phase modulator (1802; 1902) according to claim 1 arranged along said optical path.